PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Internally Sprung Wheels for Aircraft

I, GEORGE HERBERT DOWTY of 17, Lansdown Crescent, Cheltenham, Gloucestershire, of British nationality, do hereby declare the nature of this invention to be as follows:—

This invention relates to internally sprung wheels for aircraft, wherein the wheel and brake drum unit is mounted upon non-rotating hubs which are bonded together and one or both of which are slotted to permit vertical movement of such wheel unit against the action of a spring and shock absorber carried by the wheel support.

In such devices it is necessary to take the brake torque from the vertically moving wheel and brake drum unit to the fixed wheel support or axle.

The primary objects of the invention are to enable the brake torque to be transmitted with the minimum of friction and to provide means for protecting the interior mechanism of the wheel unit from dirt, mud, etc. and for cutting out the aerodynamic losses which would be set up by the slot or slots in the non-rotating hub or hubs.

According to this invention the brakes are bolted or otherwise fixed to the outer face of the non-rotating hub unit which has a vertical chamber or cylinder sliding upon the vertical cylindrical portion of a fixed ⊦ or + shaped axle member so that the brake torque is taken directly by the vertical arms of the said axle member.

The horizontal arm or arms of the said axle member hereinafter called the stub axle or axles project through the vertical slot or slots in the fixed hub or hubs and are preferably provided with flats which act as running guides against the sides of the said slot or slots to prevent "castoring" of the wheel about a vertical axis. This "castoring" effect is sometimes referred to as "toeing in" and "toeing out".

For the purpose of keeping out of the interior mechanism, dirt, mud, etc., also for streamlining the side of the slot or slots in the fixed hub or hubs, a plurality of telescoping cover plates having a lost motion between successive plates are mounted upon the stub axle or axles so as to cover the said slot or slots. These cover plates are made of such length that when telescoped together on one side, with the stub axle at the end of its slot, they do not foul the rotating portion of the wheel unit and they are each provided with such a lost motion relative to the adjacent cover plate that the slot is not uncovered before the end of the lost motion. In a preferred example of construction two cover plates only are used mounted in a slide upon the fixed hub. The outer cover plate is provided with a hole which is a tight fit upon the stub axle and the inner cover plate with a slot which slides upon the stub axle and is of less length than the outer cover plate. Suitable stops are provided to prevent the inner cover plate from fouling the rotating portions of the wheel unit.

In carrying the invention into effect according to a practical example of construction an internally sprung wheel wherein the wheel and brake drum are in one unit is mounted upon two non-rotating hubs which are formed on two castings bolted together so that the central portion of the combined unit contains a vertical cylindrical chamber which is bored out to act as a slide for a central axle member of ⊦ or + shape. The central chamber is provided with springs between the ends thereof and the said axle member and is suitably adapted to act, as a shock absorber or dash pot to the motion therebetween. One or both the fixed hubs are vertically slotted to permit vertical movement of the wheels against the action of the said springs and shock absorber. The brakes are bolted or otherwise fixed to the outer face of the non-rotating hubs and the brake backing plate or plates are slotted to permit vertical movement of the wheel. The central axle member is provided with a stub axle or alxes having vertical flats acting as guides upon the sides of the vertical slot or slots to prevent wheel

[Price 1/-]

wobble or " castoring " about a vertical axis. The brake torque from the non-rotating hub bearing is transmitted to the central axle member through the vertical cylindrical chamber and the vertical arms of the said axle member. Since these arms are of fair length the side friction is reduced to a minimum and there is no tendency for the axle member to bind on the vertically moving hub unit.

The vertical slot or slots in the hub unit are each covered by two sliding plates or covers which are mounted upon the stub axle, one upon the other, in contact with the end face of the hub. The sides of the plates run in vertical cover guides on the end faces of the hub. The plate in contact with the hub face is provided with a slot of such a length that it cannot be uncovered by the top cover plate and stops are provided to limit the end motion of the slotted cover plate and prevent it fouling the rotating portion of the wheel. The top cover plate is a tight fit upon the stub axle. The said cover plates and guides may be mounted upon a casing or cover which itself is attached to the hub unit.

In a modification the cover plate and back plate may be guided on flats on the stub axle and may be held in contact by a spring or other suitable device.

The stub axle or axles may be connected to a cantilever strut,—or to a forked mounting,—which acts as a wheel support.

Dated this 31st day of May, 1934.
For the Applicant,
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F.R.Ae.S., M.I.A.E.,
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COMPLETE SPECIFICATION

Improvements in or relating to Internally Sprung Wheels for Aircraft

I, GEORGE HERBERT DOWTY, a British Subject, of 17, Lansdown Crescent, Cheltenham, in the County of Gloucester, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to internally sprung wheels for aircraft, that is to say wheels in which there is provided resilient or shock absorbing suspension so as to allow substantially vertical movements of the wheel, subject to restraint, in relation to the axle or like part which carries it. The invention is particularly applicable to landing wheels for aircraft in which various sorts of load are required to be met, and more especially it is applicable to wheels which carry self-contained brakes housed virtually within the wheel structure. The invention seeks especially to provide means whereby forces tending to change the alignment or track of a wheel may be met adequately, even though these forces may be of such magnitude as to involve a considerable amount of wear, and possibly a considerable moment tending to produce what is sometimes called " toe-in " or " toe-out ". Particularly where a wheel is subject to braking action the forces may be so high as to require special precautions to be taken, in regard to meeting them adequately. The constructional features of the invention also provide means for protecting the interior mechanism of the wheel against the entry of undesired dirt or water, and they also provide what may well be an economical device from the manufacturing point of view.

In various constructions of sprung or resilient wheels it has previously and frequently been proposed to provide a shock absorber adapted to be contained within the wheel, and of substantially cylindrical telescopic form. But in relation to such devices the guiding means proposed in order to meet moments tending to misalign the wheel have been improved upon by the present invention. For example, in one previous proposal a cylindrical telescopic device was proposed to be longitudinally splined; this is regarded as being a more costly and possibly less effective guide means than that of the present invention. Again, in other proposals, the axle part was proposed to cross the wheel and to be encircled by bearings on each side thereof so that guides were disposed bilaterally and symmetrically in relation to the shock absorber. In aircraft wheels however, where cleanness of outline and lightness of weight are factors of great importance, a type of wheel is generally required which is not symmetrical, and into which an axle extends, from one side only. It is also desirable to minimise

the size of bearings as far as possible, and to facilitate rapid and easy assembly and dismantling as far as possible.

According to the invention an internally sprung wheel is provided with a wheel-bearing on each side, each wheel-bearing being carried on a half of a longitudinally halved or divided sleeve which is slidable upon a cylindrical guide, which guide is rigid with an axle which projects through an encircling one of said wheel-bearings, and is slidable (parallel with the sleeve and its guide) in a guideway which is mounted at the side of said encircling wheel-bearing remote from the sleeve and its guide. Further, the sleeve and its guide may themselves include or comprise a telescopic shock absorbing resilient device, and the sleeve, in order to allow the sleeve guide and axle their proper freedom, may be longitudinally slotted, and thus the sleeve guide may be made like the head of a T rigidly attached to or integral with, the axle. The construction thus formed allows the convenient closure of the space in which the axle moves relative to the wheel, and by a pair of slidable plates which, although allowing the required scope, do not themselves have to move so far that they might foul the wheel or tyre. Further, the construction allows the feature to be embodied, that a brake drum formed within the thickness of the wheel and therefore minimising drag, lies substantially in the plane of the guideway which is on the outer side of the encircling wheel bearing, so that misaligning moments set up by drag effect may be directly met by the guideway. The invention will now be described in relation to a typical embodiment in order that the manner of its performance may be better understood. The accompanying drawings show, in Figure 1 a vertical elevation in section taken substantially through the axis of rotation of the wheel and also the axis of the shock absorbing device and stub axle, and in Figure 2 an inner side elevation, the right-hand half being in a plane external to the wheel as a whole, and the left-hand half being an elevation of the shock absorber part only, within the wheel, but from the same point of view.

In these drawings the wheel comprises a peripheral rim 1 suitably adapted in any known manner to support a tyre, an indication of which is given at 2. One flange of the rim is detachable for the purpose of removing or replacing the tyre. It will be convenient to regard the two sides of the wheel as being outer and inner; the outer side, which may be faired by a light fairing 3, comprises a substantially annular but slightly dished plate 4 which connects the rim 1 with an outer bearing element 5 with any suitable bushing such as is shown at 6, and running on an inner bearing boss or hub 7. The manner in which the bearing is constructed or held together, although illustrated clearly, is not of importance to the invention, except as a contributory factor. On the inner side of the wheel a conical and annular web 8 (which may support and present for use a lubricator such as 9, connected by a conduit 10 to the inner bushes 11) connects the rim 1 to an inner wall part 12 of the wheel. An inwardly directed cylindrical surface at 13 of the wall 12, when suitably lined for example with a steel liner (which may be secured detachably as by bolts 13A), forms the brake drum. Further inward, the wall 12 is broadened out into a cylindrical flange 12A to carry the outer of the bushes 11, and thus forms the rotating part of the inner wheel bearing. This bearing is large in diameter, as compared to the outer bearing on the boss 7, being in fact sufficiently large to permit the desired resilient travel of the wheel. The inner non-rotating part of this large bearing is formed by a cylindrical axial boss or extension 14.

The boss 7 and the part 14 are formed integrally with (but may be attached to), a substantially vertical tube or sleeve 15 which is preferably lined as shown at 16, and which forms the mobile part of the shock absorber device, being in effect an outer telescoping tube. It should perhaps be mentioned that the shock absorbing device comprises virtually one cylindrical member mounted for sliding on the outside of another, the whole housing the springing and damping means. The parts 15 and 16 in this example constitute the outer sliding member, and they of course move substantially vertically with the wheel. The inner cylindrical member is shown at 17, and it constitutes a cylindrical tubular portion carried in T-fashion on the extremity of the stub axle 18, which may also be tubular. Although as illustrated, the axis of the cylinder 17 is vertical, it may of course be slightly out of the vertical either in accordance with the attitude of the aircraft, or for other reasons. The stub axle 18 may well be the lower horizontal extremity of a cantilever undercarriage leg, or may be attached thereto.

In a fitting 19 plugged into the upper end of the cylinder 17, there is borne an inner cylindrical stem 20 which may form a hydraulic dashpot in which

operates the damping piston 21, and a recoil spring 22 surrounding the damping piston rod 23 which is anchored in a fitting 24 in the lower end of the tube 15. Bearing between the fittings 19 and 24 is the main suspension spring parts of which are shown at 25 which is in compression. Means for replenishing the dashpot comprises a tubular housing 26 placed diametrically in the fitting 19, and having therein a non-return mushroom valve 27 adapted to be opened by the pressure of the spout of a filling funnel indicated at 28. This contrivance ensures that the dashpot may always be filled to a given level. Access to the device, for the funnel 28, is through suitable holes in the parts 3 and 4, which must of course be brought into appropriate register with the valve 27, before inserting the funnel.

It should be clear that the stub axle 18 enjoys vertical freedom of movement within the axial opening of the part 14. The non-rotating parts of the brake comprise an annulus 30 which is carried rigidly with the part 14 and which presents peripherally a channel at 31 in which is fitted any suitable brake shoe, for example one which can be expanded radially by fluid pressure. It will be observed that the brake as a whole is contained virtually within the thickness of the wheel, and the inner face of the wheel presents a relatively smooth contour which may be completed by a fairing member such as 32.

Because the resilient suspension is of a cylindrical order, it does not afford any proper means for withstanding moments about its substantially vertical axis; such moments will, if allowed, produce misalignments of the wheel, possible shimmying, or toe-in and toe-out. Provision is made to meet these forces by providing on the stub axle 18 a pair of flats best seen at 33 (Fig. 2) which are substantially vertical and are parallel with the axis of the cylinder 17. Upon these flats there bear two rubbing bearing pieces 34, which are likewise vertical and which are rigid with the parts 14 and 30. They form parallel tracks bearing on the flats 33 to prevent misalignments of the wheel in track, and since they are well removed from the axis of the cylinder 17, they are capable of withstanding the undesired moments without being very heavy or rugged. They extend vertically for a sufficient distance to accommodate the maximum vertical movements of the wheel relative to the stub axle 18, whilst supporting the flats 33. As can be seen, more especially from the left side of Figure 2, the construction so far described leaves an open slot either below or above the stub axle 18, in which it travels, and through which dirt or the like might enter. Provision is made for guarding against this by having two sliding plates the inner of which is shown at 35 and which is stopped in upward travel by a rivet 36 and on its downward travel by rivet 38; this plate 35 has a downwardly directed opening to allow free relative downward movement of the stub axle 18 up to a certain point, after which further downward movement of 18 will by abutment against the edge 35A, constrain the plate 35 to move down with 18. An outer plate 37 is perforated so as to embrace the stub axle 18 closely. This outer plate 37 extends upwardly beyond the stop 36, but not so far as to project radially beyond the fixed brake part 31. When the wheel reciprocates vertically relative to the stub axle 18, the outer plate 37 moves with 18 and keeps covered over the slot in the plate 35. The plate 35, however, completes the protection of the inner parts which the plate 37 cannot wholly effect because of the dimensional limitations imposed upon it, owing to the fact that it must not be allowed to extend radially over a rotating part of the wheel. The two plates are slidably guided by suitably attached vertical and parallel guide tracks 39.

As can be seen from Figure 2, the sleeve 15 is built up in two halves bolted together through the medium of flanges 15A to facilitate its assembly upon the cylinder 17, and it is thus virtually in two halves, one of which carries the boss 7 and the other of which carries the part 14. Its liner 16 may be divided or not, but preferably is. Any suitable lubricating means may be provided for any of the working parts, and it will be seen that no part to which ready access may be desired is so arranged as to be badly inaccessible.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. An internally sprung wheel provided with a wheel-bearing on each side, each wheel-bearing being carried on a half of a longitudinally halved or divided sleeve which is slidable upon a cylindrical guide, which guide is rigid with an axle which projects through an encircling one of said wheel-bearings, and is slidable (parallel with the sleeve and its guide) in a guideway which is mounted at the side of said encircling wheel-bearing remote from the sleeve and

its guide.

2. A wheel according to Claim 1, in which the sleeve and its guide include or comprise a telescopic shock absorbing resilient device.

3. A wheel according to Claim 1 or 2, in which the sleeve is longitudinally slotted to permit sliding of the axle and sleeve guide relative thereto.

4. A wheel according to any previous claim, in which the sleeve-guide is a cylinder fixed like the head of a T to the axle.

5. A wheel according to any previous claim, in which closure of the space through the guideway in which the axle slides is effected by a pair of slidable plates adapted to permit the desired relative movements.

6. A wheel according to any previous claim, in which a brake drum formed within the thickness of the wheel is provided, the guideway lying substantially in the plane of the brake and being surrounded by the drum.

7. A resilient or sprung wheel for aircraft, having the bearings, shock absorbing means, guiding means, and brake, constructed and adapted to operate substantially as described and illustrated.

Dated the 10th day of May, 1935.

For the Applicant,
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Chartered Patent Agents,
29, Southampton Buildings, London,
W.C. 2.

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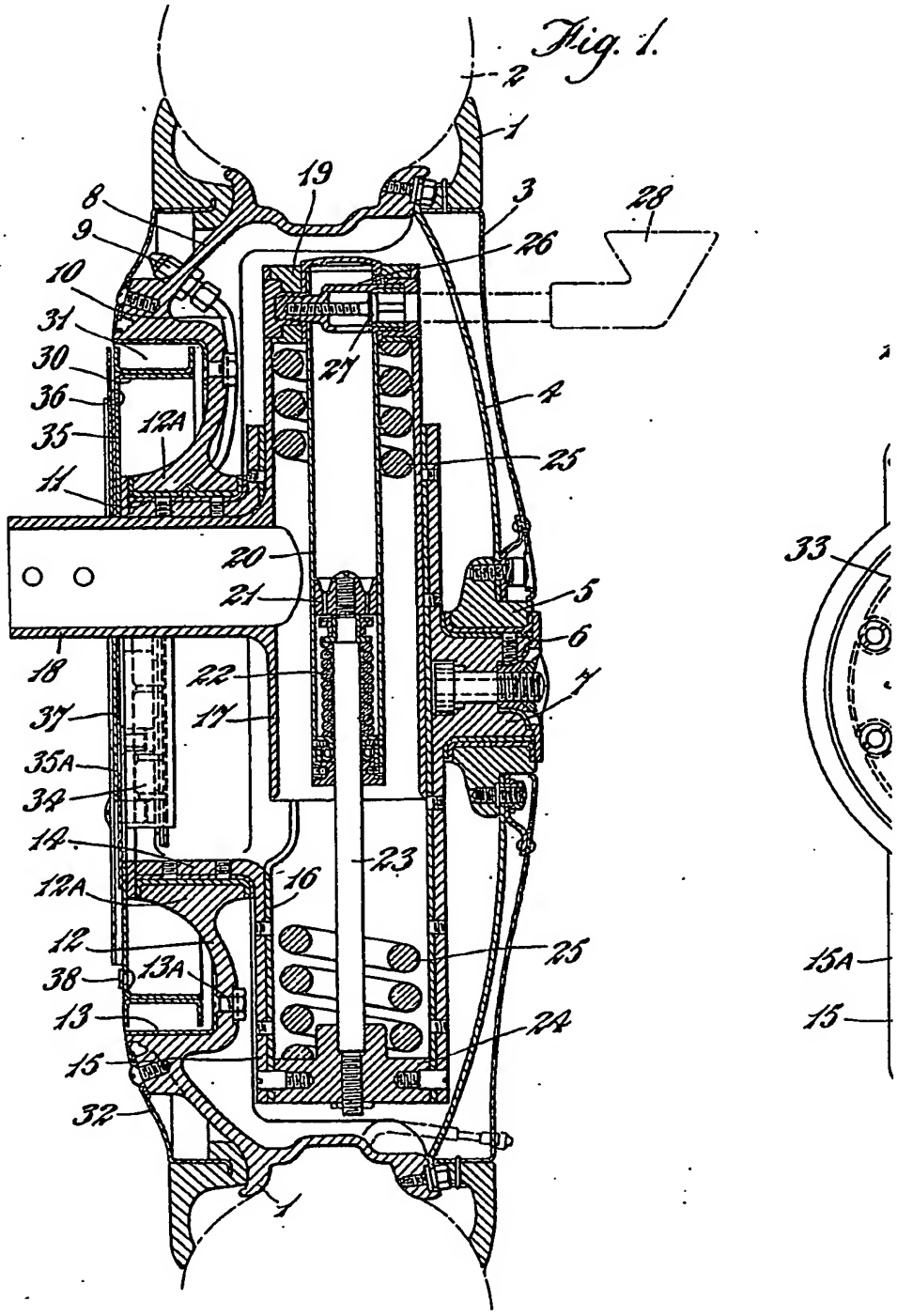
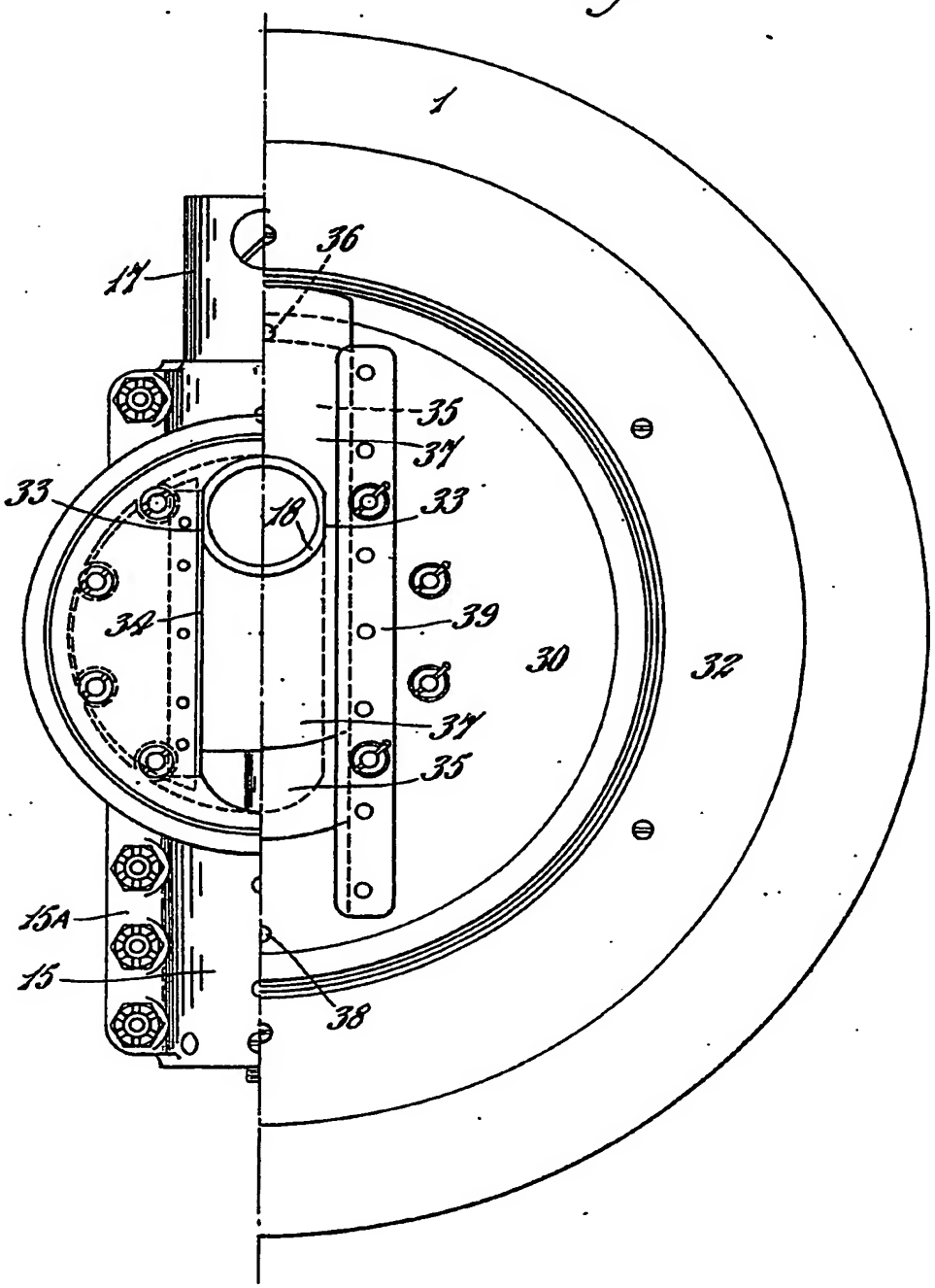
[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.



1 SHEET

Fig. 2.



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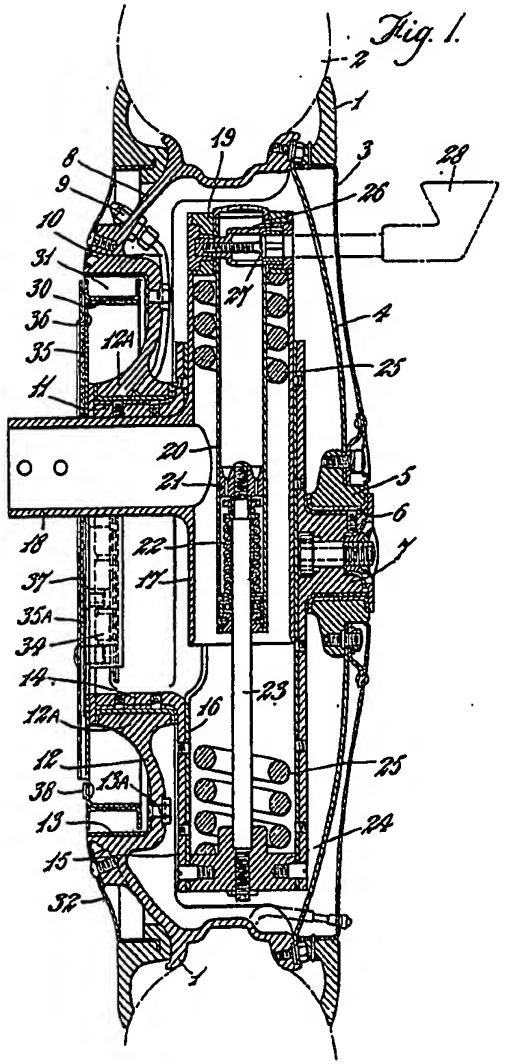
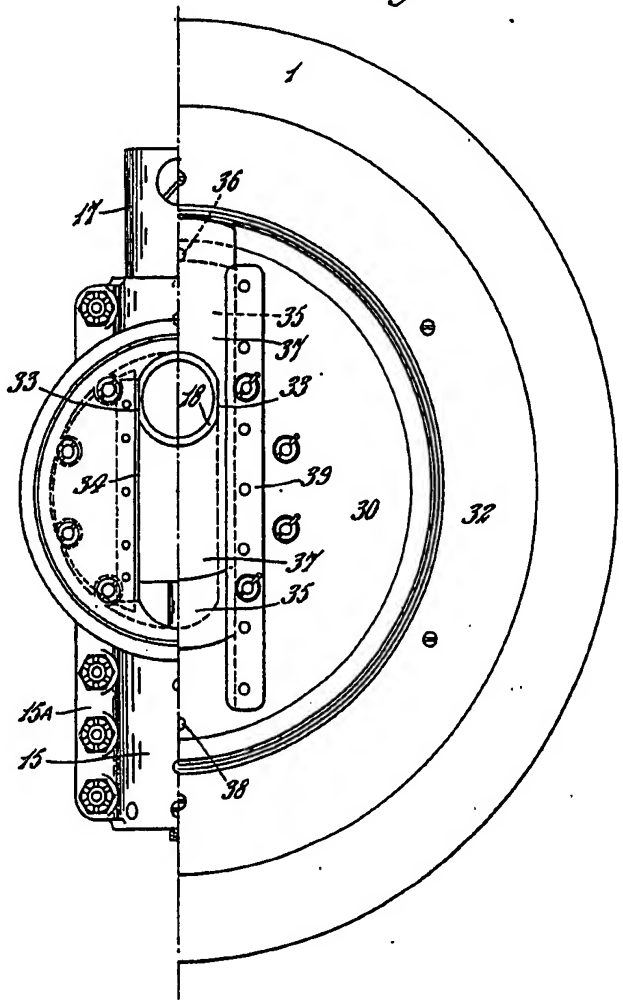


Fig. 2.



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